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(71) Applicant *(for all designated States except US)*: **AUTOLIV DEVELOPMENT AB** [SE/SE]; S-447 83 Vårgårda (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **GOLDBERG, Fred** [SE/SE]; Box 1210, S-181 24 Lidingö (SE). **GAWELL, Nils** [SE/SE]; Drabantvägen 6B, S-181 65 Lidingö (SE).

(74) Agent: **LINDSTRÖM, Bo, Åke**; Autoliv Development AB, S-447 83 Vårgårda (SE).

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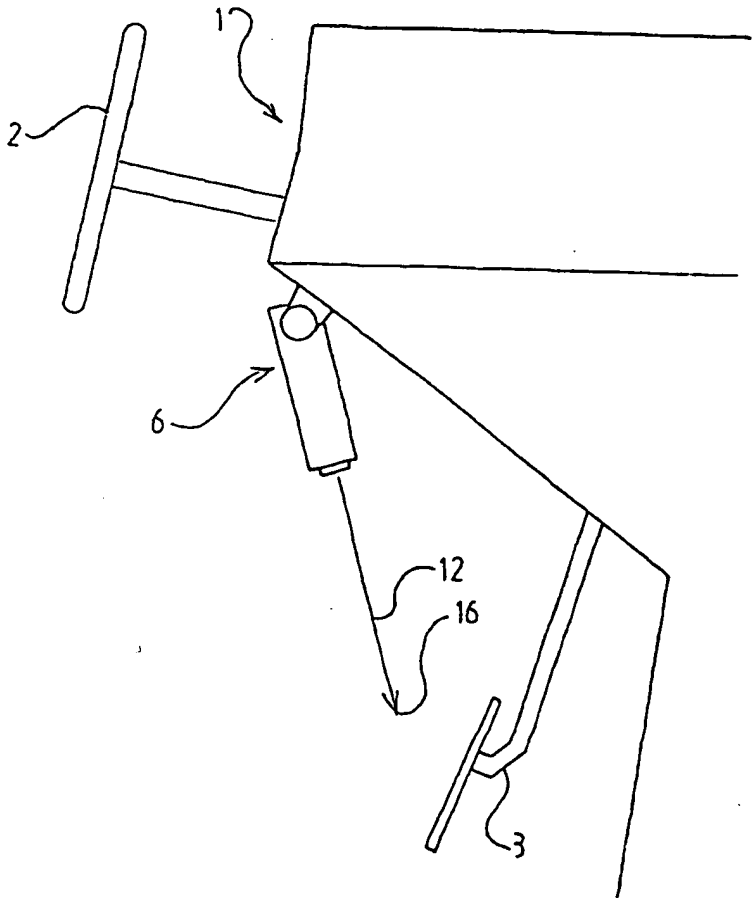
(54) Title: IMPROVEMENTS IN OR RELATING TO A BRAKE-LIGHT ARRANGEMENT



(57) Abstract: A brake-light arrangement in a motor vehicle includes a control system (21) which receives inputs from an optical sensor (20) which detects a predetermined movement of a foot of the driver of the vehicle relative to the brake pedal, a speedometer (23) which provides a signal indicating whether the vehicle is stationary or moving, and a deceleration unit (24) which provides a signal relating to the instantaneous deceleration of the vehicle. The control system (21) controls a flasher/timer (29) which in turn controls light-emitting diode brake-lights. The lights flash with a first predetermined frequency when a relatively low deceleration exists and flash with a higher frequency when a relatively high deceleration exists.

WO 01/53133 A1

Improvements in or relating to a brake-light arrangement

THE PRESENT INVENTION relates to a brake-light arrangement for use in a motor vehicle.

Every year a large number of accidents occur in which a first motor vehicle, "the vehicle in front", is run into by a second vehicle, "the vehicle behind". These accidents, termed "rear end collisions", may give rise to injuries for the occupants of the vehicle in front. These injuries may be "whip-lash" injuries which very often take a long time to heal and which may be very expensive to treat.

The major case of a rear end collision is that the vehicle behind did not stop in time. There may be many reasons for this occurrence. In many cases the distance between the car behind and the car in front was too short, bearing in mind the speed of the vehicles. Alternatively the driver of the vehicle behind may not have noticed that the vehicle in front was actually braking until the distance between the vehicles was too short. Also, the driver of a vehicle approaching from behind may not notice that the vehicle in front is actually standing still.

Many rear end collisions occur at a time when the vehicle in front has its lights illuminated. Thus the vehicle in front is showing rear red lights, and when the brakes are applied the intensity of the rear red lights simply increases. The driver of the vehicle behind may not notice the increase in intensity of the red lights at the rear of the vehicle in front.

It is important that the driver of a vehicle behind should be alerted, as soon as possible, to the fact that the vehicle in front is braking. At a speed of 100 km per hour, a vehicle covers 27.7 metres every second. In other words, a vehicle covers a distance equivalent to the length of five typical motor cars in a single second. If a driver starts braking 0.2 seconds sooner, the vehicle will stop in a distance which is shorter by over 5 metres, and thus in some cases a collision may be avoided.

The present invention therefore seeks to provide an improved brake-light arrangement which, in use, may very rapidly alert the driver of a vehicle behind the vehicle provided with the brake-light arrangement to the fact that the vehicle is braking.

According to this invention there is provided a brake-light arrangement provided in a motor vehicle, the brake-light arrangement incorporating a control system, the control system receiving input signals from a first unit adapted to respond to a predetermined movement of a foot of the driver of the vehicle relative to the brake pedal, a second unit providing a signal related to the instantaneous deceleration of the vehicle, the control system being adapted to control rapidly illuminating brake-lights to be illuminated when the predetermined movement of the foot has been sensed, the brake-lights being controlled to flash with a first predetermined frequency when a deceleration exists which is less than a predetermined threshold, and to flash with a second

higher frequency when a deceleration exists which is equal to or greater than the threshold.

In this Specification the term "rapidly illuminating brake-lights" is used to refer to brake-lights which become illuminated almost instantaneously when provided with electrical current, in contrast to conventional brake-lights, such as incandescent bulbs, which take, relatively, a long time to become fully illuminated. Preferably the brake-lights are light-emitting diode brake-lights, such as so-called laser diode lights. Alternatively gas-discharge brake-lights may be used.

Preferably the first frequency is approximately 2 Hz, and conveniently the second frequency is approximately 5 Hz.

Conveniently a timer is provided so that whenever the lights are illuminated with the second frequency of flashing, they remain illuminated with that second frequency of flashing for a predetermined period of time.

Preferably the period of time is approximately three seconds.

Conveniently the deceleration sensor is adapted to provide an output signal which is corrected in dependence upon the inclination of the vehicle.

Preferably a deceleration sensor is provided, an output from the deceleration sensor being provided to a delay device, the output of the delay device being subtracted from the instantaneous output of the deceleration sensor to provide said output signal corrected in dependence upon the inclination of the vehicle.

Advantageously the means adapted to sense the predetermined movement of the foot comprise means generating a beam of light directed towards a predetermined region relative to the brake pedal, and means to sense light reflected from said predetermined region relative to the brake pedal.

Conveniently the light is infra-red light.

Preferably the light is directed, by means of a lens collimator, to form a "pencil" beam directed towards said region.

Conveniently a light detector is provided associated with a lens collimator arrangement so that the detector can receive light from the region.

Preferably the light is modulated by a modulator, and an output signal from the detector is compared with an output signal from the modulator by a comparator.

Conveniently the control system receives input signals from an ABS unit in the vehicle, the control system being adapted to control the rapidly illuminating brake-lights to flash with said second, higher, frequency when the ABS unit senses a locked wheel during braking.

Advantageously the control system receives a signal from a unit responsive to pressure applied to the brake pedal, the control system being adapted to control the brake-lights to be illuminated whenever pressure is applied to the brake pedal.

In one embodiment of the invention the control system receives an input from a third unit which provides a signal indicating whether the vehicle is stationary or moving, and the brake lights are also controlled to be illuminated with a steady illumination when the vehicle is stationary.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a diagrammatic side view of a brake-pedal operation sensor unit,

FIGURE 2 is a front view of the sensor unit of Figure 1,

FIGURE 3 is a block diagram of a sensor unit of Figures 1 and 2,

FIGURE 4 is a block diagram of a brake-light arrangement, and

FIGURE 5 is a further block diagram in the form of a flow chart.

In a brake-light arrangement in accordance with the invention, a sensor unit is provided which senses movement of the right foot of the driver of the motor vehicle towards the brake pedal. When this sensor unit senses movement of the foot of the driver towards the brake pedal a sequence of events is initiated. Initially a very fast illuminating brake-light is caused to be illuminated, flashing at a first frequency. As soon as a deceleration of more than a predetermined threshold is sensed, the flashing frequency of the brake-light is increased to a second, higher, predetermined frequency. Whenever the

brake-light flashes at the second predetermined frequency, it will maintain flashing at that frequency for at least a predetermined period of time, even if the deceleration rate subsequently decreases. As soon as the vehicle is stationary, the rear light is illuminated with no flashing.

Referring initially to Figures 1 to 3, a sensor unit is illustrated which is adapted to sense movement of the right foot of the driver of the motor vehicle towards the brake pedal.

Referring to Figure 1, the dashboard 1 of the motor vehicle is illustrated together with the steering wheel 2 and the brake pedal 3. As can be seen in Figure 2, the brake pedal 3 is located centrally, in this embodiment, between an accelerator pedal 4 and a clutch pedal 5.

Mounted beneath the dashboard is a housing 6. The housing 6 contains the components of an infra-red sensor arrangement which will be described in conjunction with Figure 3.

The infra-red sensor incorporates an infra-red lamp 10. The infra-red lamp 10 is associated with a lens/collimator arrangement 11 adapted to generate a "pencil" beam of light 12. Such a beam is a non-divergent beam of relative small dimension. The pencil beam 12 is directed towards the brake pedal 3. The sensor arrangement incorporates a second lens collimator arrangement 13 which is adapted to direct light on to an infra-red detector 14. The lens/collimator 13 is such that only light present within a relatively narrow "pencil" beam 15 will be focused on to the infra-red detector. The arrangement of the lens/collimator 11 and the lens/collimator 13 is such that the "pencil" beam 12 and the "pencil" beam 15 intersect at a predetermined region. The region where the beams intersect, namely the region 16, as shown in Figures 2

and 3, is located approximately 50-60 millimetres away from the brake pedal 3, as measured relative to the plate of the brake pedal, and approximately 10 millimetres from one side edge of the brake pedal. The region is located approximately 150 millimetres beneath the housing 6.

When the foot of a driver of the vehicle moves his or her foot to a position above the brake pedal 3, part of the shoe of the occupant will pass through the region 16. As the shoe passes through this region 16, the infra-red light within the pencil beam 12 will be directed on to the shoe, and since the illuminated part of the shoe will be within the "pencil beam" 15 defined by the lens collimator 13, a "reflection" of the infra-red light will be directed on to the infra-red detector.

In order to prevent false "signals" being detected by the infra-red detector 14 as a consequence of sun light, it is preferred that the infra-red lamp 10 is modulated by a modulator 17. The modulator may be a frequency modulator, or may be a pulse code modulator. It is to be appreciated that if the infra-red lamp is modulated, any reflected light detected by the infra-red detector which originated with the infra-red lamp will be modulated light. Thus the output from the infra-red detector 14 is passed to a comparator 18 which also receives a direct signal from the modulator 17. The comparator 18 compares the output of the detector 14 with the output of the modulator 17. The output of the comparator 18 is passed to a discriminator 19. The discriminator 19 will be able to determine if the infra-red detector 14 has detected light that originated from the infra-red lamp 10. If the discriminator determines that the infra-red detector has detected light of this type, a situation exists in which the brake pedal is about to be operated, since the foot of the driver has been moved to a position above the brake pedal.

Turning now to Figure 4, the optical sensor arrangement that has been described above is shown in Figure 4 as the brake pedal optical sensor 20. The output of the brake pedal optical sensor 20 is supplied as one input to a control system 21. A further input to the control system 21 comprises the output of a brake pedal pressure sensor unit 22. The brake pedal pressure sensor unit may comprise a pad of pressure-sensitive material mounted on the brake pedal, thus providing an output signal as soon as the brake pedal is actually pressed. Alternatively, the brake pedal pressure sensor unit may be the pressure switch that is conventionally provided adapted to respond to an increase in pressure in the brake fluid within the brake system, caused by depression of the brake pedal, to operate the brake-lights. In any event, the brake pedal pressure sensor will provide an output to the control arrangement 21 whenever pressure is applied to the brake pedal.

A further input to the control arrangement 21 is an input from the speedometer 23 of the vehicle. The speedometer acts as a unit which provides a signal indicating whether the vehicle is stationary or moving. This is provided so that the control arrangement can determine whether the vehicle is actually moving, or whether the vehicle is actually stationary.

Another input to the control arrangement 21 is the output of a deceleration sensor unit 24 which senses the instantaneous deceleration of the vehicle.

A typical deceleration sensor, as conventionally used, may incorporate a swinging pendulum, or some other inertia member. A problem with such deceleration sensors is that erroneous signal can be provided if the deceleration sensor is present in a vehicle which is travelling up-hill or down-hill. Thus there is an error which relates to the instantaneous inclination of the vehicle.

Consequently, in the particularly described embodiment of the invention, the deceleration sensor unit 24 incorporates a deceleration sensor 25, an output of which is provided to a delay line 26. The delay line may have a delay of, typically, 1 second. The output from the delay line 26 is subtracted by a subtractor 27 from a further output of the deceleration sensor 25. The output from the subtractor constitutes the output of the deceleration sensor unit 24. By utilising an arrangement as described if the vehicle is travelling up-hill or down-hill, thus having a particular inclination, the deceleration sensor 25 will provide an output equivalent to a predetermined deceleration. However, should the vehicle suddenly brake, the sensed deceleration will change, as a consequence of the braking. By subtracting, from the instantaneous output of the deceleration sensor 25, the value of the output one second previously, it is possible to generate a signal which is very closely related to the actual deceleration of the vehicle.

A final input to the central arrangement 21 comes from an ABS (Antilock Braking System) control unit 28. Such a unit releases the braking briefly if the wheels should lock, for example when braking hard on ice or gravel or a wet road.

The control arrangement 21 is adapted to provide signals to control a flasher timer circuit 29. The flasher/timer circuit is adapted to perform three functions. The first function is to provide an output signal directed to very fast acting red brake-lights, such as light-emitting diode lights 30, or so-called laser diodes mounted on the rear of the vehicle. the output signal will cause the light-emitting diode lights 30 to flash at a first predetermined flash rate, such as a flash rate of 2 Hz. The second function of the flasher/timer is to cause the light-emitting diode lights 30 to flash at a second predetermined flash rate, which is greater than the first flash rate, such as a flash rate of 5 Hz. The

flasher/timer circuit 29 is arranged so that whenever the light-emitting diode lights 30 are caused to flash at the second flash rate, they always flash at that rate for a period of time of at least three seconds. The third function of the flasher/timer circuit 29 is to cause the light-emitting diode lights 30 to be illuminated with a steady illumination, that is to say with no flashing at all.

Light-emitting diode lights 30 are used since such lights may be fully illuminated in a period of time which is at least 0.2 seconds shorter than the time taken to illuminate a typical incandescent bulb as used in a vehicle brake light. Other fast acting light sources may be used, such as certain types of discharge lamp where the lamp may be fully illuminated in a very brief period of time.

Referring now to Figure 5 of the accompanying drawings, which is to be read in conjunction with Figure 4, the described brake-light arrangement follows a predetermined sequence of operations. If the brake pedal optical sensor 20 senses the brakes are about to be operated or, if for some reason the brake pedal optical sensor does not provide an output signal, and a signal is generated by the brake pedal pressure sensor, then a sequence of events is followed which leads to illumination of the light-emitting diode lights 30.

As an initial step in the sequence of events the control arrangement 21 determines if the vehicle is moving. If the vehicle is not moving, the brake-lights are illuminated with no flashing. If the vehicle is moving, the control arrangement determines the current deceleration rate of the vehicle. If the deceleration rate is less than 0.3 g, then the light-emitting diode lights 30 are caused to flash with a flash rate of 2 Hz. Thus, if a driver simply moves his or her foot to "hover" over the brake pedal, the arrangement will sense that the brake pedal is about to be operated, will determine that the vehicle is moving

and will determine that there is no present deceleration, and the brake-lights will be flashed at a rate of 2 Hz. The control arrangement 21 may effectively turn off the brake light if the brake pedal is not pressed within a predetermined time of, for example, one second. If the driver is moving his or her foot rapidly towards the brake pedal to effect an "emergency" stop, the brake-lights will be illuminated as soon as the foot is detected by the optical sensor 20. In an alternate situation in which a person has gently applied the brakes and is braking with a deceleration of, say, 0.2 g, the brake-lights will also flash at 2 Hz. Thus, the driver of a following vehicle will be alerted to the fact that the vehicle in front is about to brake, or is braking gently, just as soon as is practicable.

If the vehicle is moving the control arrangement 21 will determine if the ABS unit has been actuated. If it has, because the vehicle is braking hard, the lights 30 will be caused to flash at a frequency of 5 Hz.

Should, at any stage during the braking process, the sensed deceleration exceed 0.3 g, then the lights will be caused to flash at a frequency of 5 Hz. If ever the lights are caused to flash at a frequency of 5 Hz, they flash at that frequency for at least three seconds. Thus, if during a braking cycle a deceleration rate of 0.3 g or more is sensed, or if the ABS is activated, the light-emitting diode lights will flash at a relatively high rate for a period of time sufficient to ensure that the driver of the vehicle behind will observe the high rate of flashing, and will thus appreciate that the vehicle in front is braking severely.

When the vehicle comes to a stop, the brake-light arrangement will determine that the vehicle has stopped moving and the brake-lights will then be illuminated with no flashing.

It is to be understood that it is not essential for the optical sensor 20 to sense the foot of the driver in the region 16 adjacent the brake pedal for the brake lights to be illuminated. The control system 21 will always illuminate the brake lights when a pressure is applied to the brake pedal which is sensed by the brake pedal pressure sensor 22.

The described system will enable the driver of the vehicle behind to appreciate, at the earliest possible moment, the nature of the braking being effected by the vehicle in front.

In the present specification "comprise" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A brake-light arrangement provided in a motor vehicle, the brake-light arrangement incorporating a control system, the control system receiving input signals from a first unit adapted to respond to a predetermined movement of a foot of the driver of the vehicle relative to the brake pedal, a second unit providing a signal related to the instantaneous deceleration of the vehicle, the control system being adapted to control rapidly illuminating brake-lights to be illuminated when the predetermined movement of the foot has been sensed, the brake-lights being controlled to flash with a first predetermined frequency when a deceleration exists which is less than a predetermined threshold, and to flash with a second higher frequency when a deceleration exists which is equal to or greater than the threshold.

2. An arrangement according to Claim 1 wherein the brake-lights are light-emitting diode brake-lights.

3. An arrangement according to Claim 1 or 2 wherein the first frequency is approximately 2 Hz.

4. An arrangement according to any one of the preceding Claims wherein the second frequency is approximately 5 Hz.

5. An arrangement according to any one of the preceding Claims wherein a timer is provided so that whenever the lights are illuminated with the second frequency of flashing, they remain illuminated with that second frequency of flashing for a predetermined period of time.

6. An arrangement according to Claim 5 wherein the period of time is approximately three seconds.

7. An arrangement according to any one of the preceding Claims wherein the deceleration sensor is adapted to provide an output signal which is corrected in dependence upon the inclination of the vehicle.

8. An arrangement according to Claim 7 wherein a deceleration sensor is provided, an output from the deceleration sensor being provided to a delay device, the output of the delay device being subtracted from the instantaneous output of the deceleration sensor to provide said output signal corrected in dependence upon the inclination of the vehicle.

9. An arrangement according to any one of the preceding Claims wherein the means adapted to sense the predetermined movement of the foot comprise means generating a beam of light directed towards a predetermined region relative to the brake pedal, and means to sense light reflected from said predetermined region relative to the brake pedal.

10. An arrangement according to Claim 9 wherein the light is infra-red light.

11. An arrangement according to Claim 9 or 10 wherein the light is directed, by means of a lens collimator, to form a "pencil" beam directed towards said region.

12. An arrangement according to any one of Claims 9 to 11 wherein a light detector is provided associated with a lens collimator arrangement so that the detector can receive light from the region.

13. An arrangement according to any one of Claims 9 to 12 wherein the light is modulated by a modulator, and an output signal from the detector is compared with an output signal from the modulator by a comparator.

14. An arrangement according to any one of the preceding Claims wherein the control system receives input signals from an ABS unit in the vehicle, the control system being adapted to control the rapidly illuminating brake-lights to flash with said second, higher, frequency when the ABS unit senses a locked wheel during braking.

15. An arrangement according to any one of the preceding Claims wherein the control system receives a signal from a unit responsive to pressure applied to the brake pedal, the control system being adapted to control the brake-lights to be illuminated whenever pressure is applied to the brake pedal.

16. An arrangement according to any one of the preceding claims wherein the control system receives an input from a third unit which provides a signal indicating whether the vehicle is stationary or moving, and the brake lights are also controlled to be illuminated with a steady illumination when the vehicle is stationary.

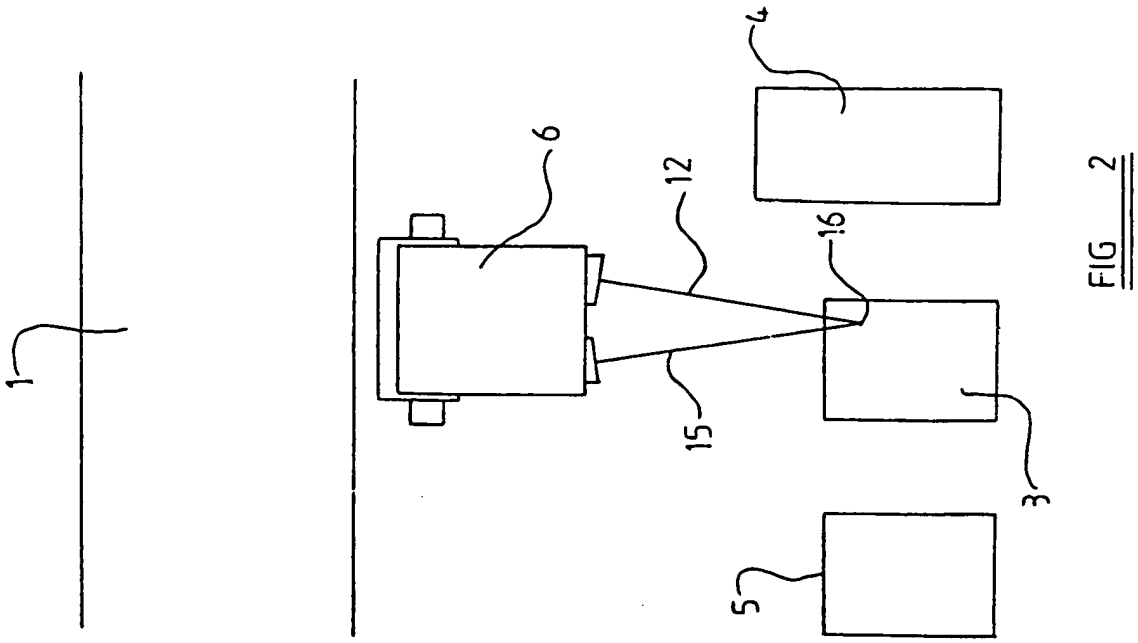


FIG 2

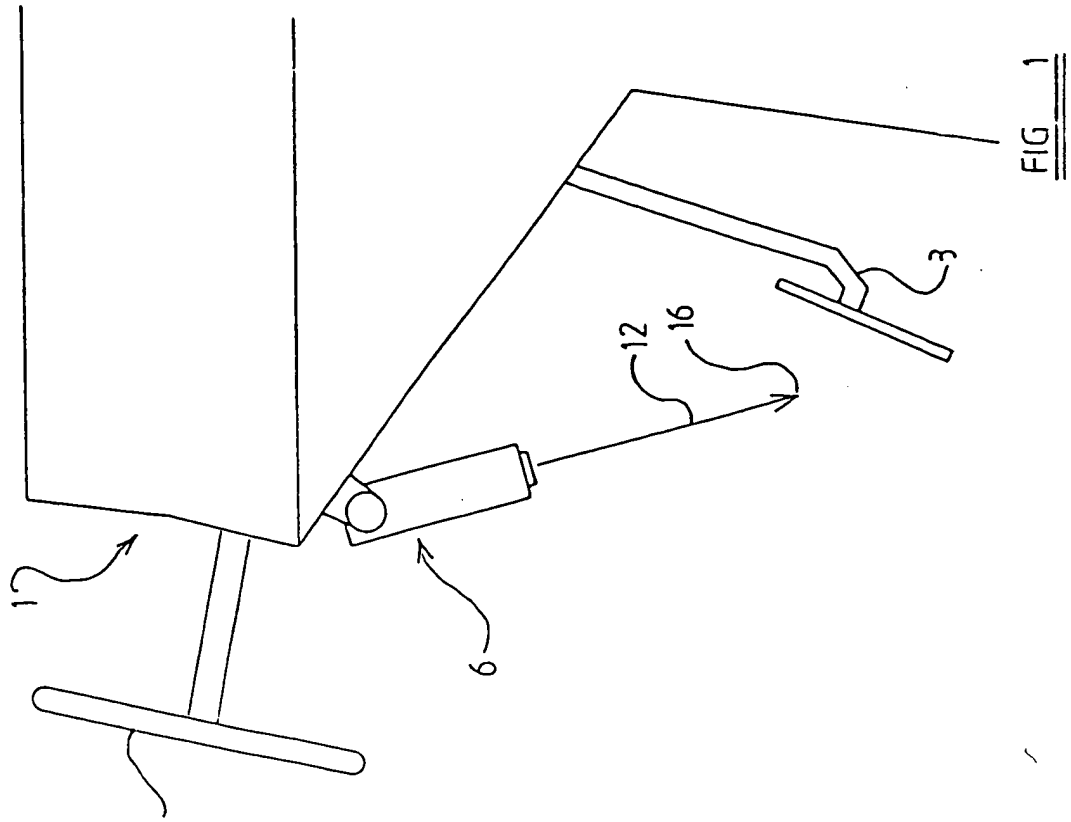


FIG 1

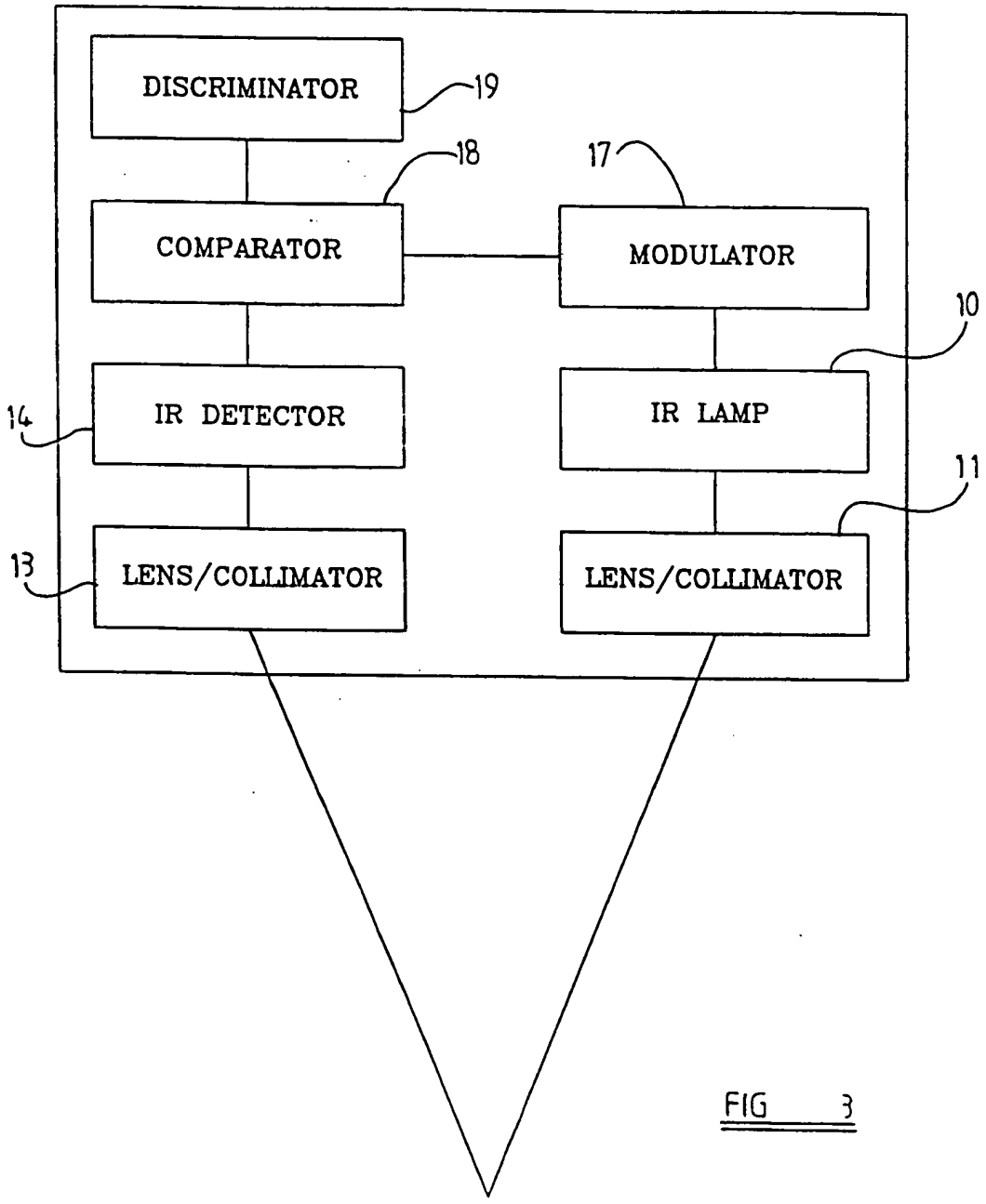

DISCRIMINATOR
19
18
17
COMPARATOR
MODULATOR
10
14
IR DETECTOR
IR LAMP
11
13
LENS/COLLIMATOR
LENS/COLLIMATOR

FIG 3

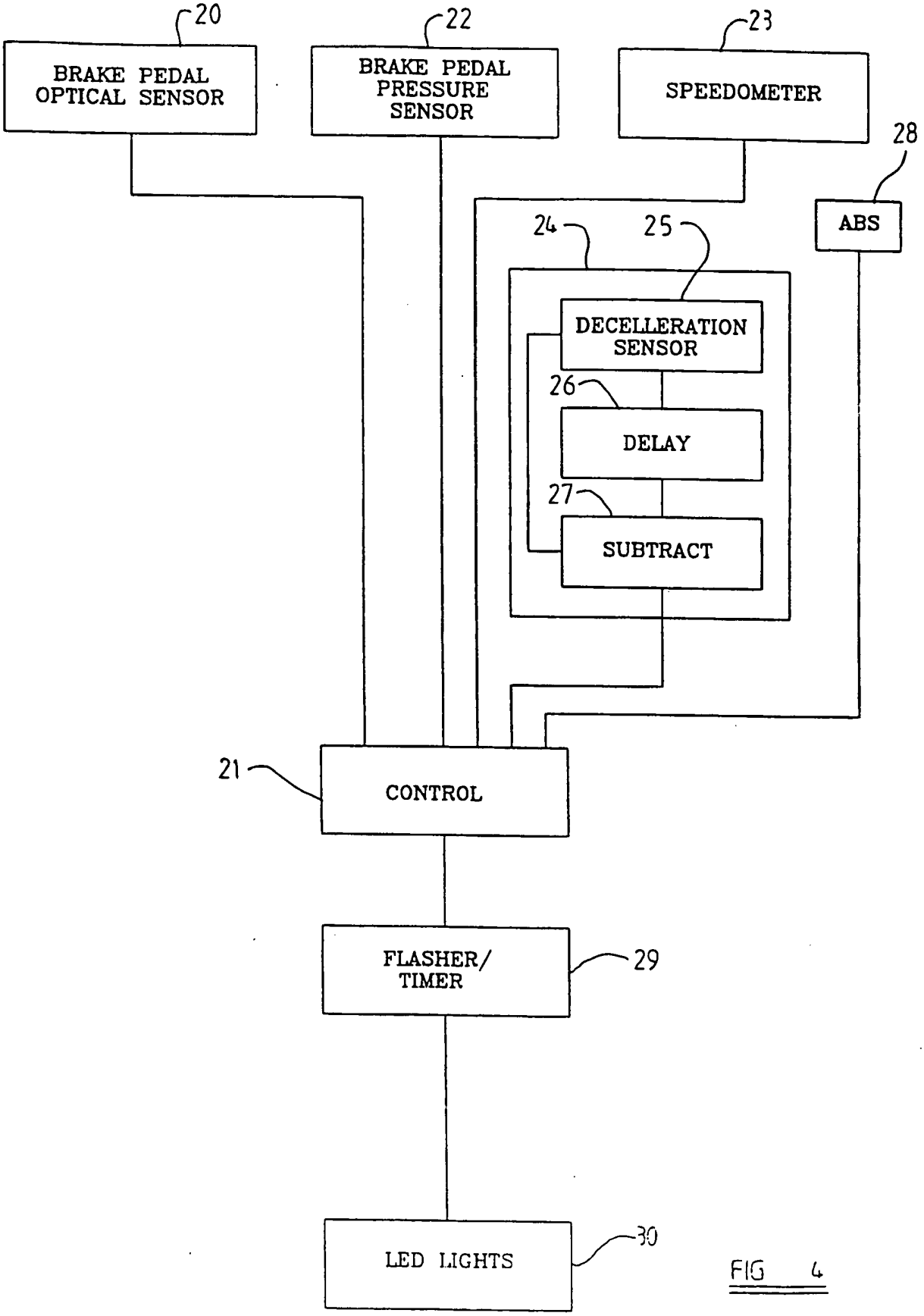
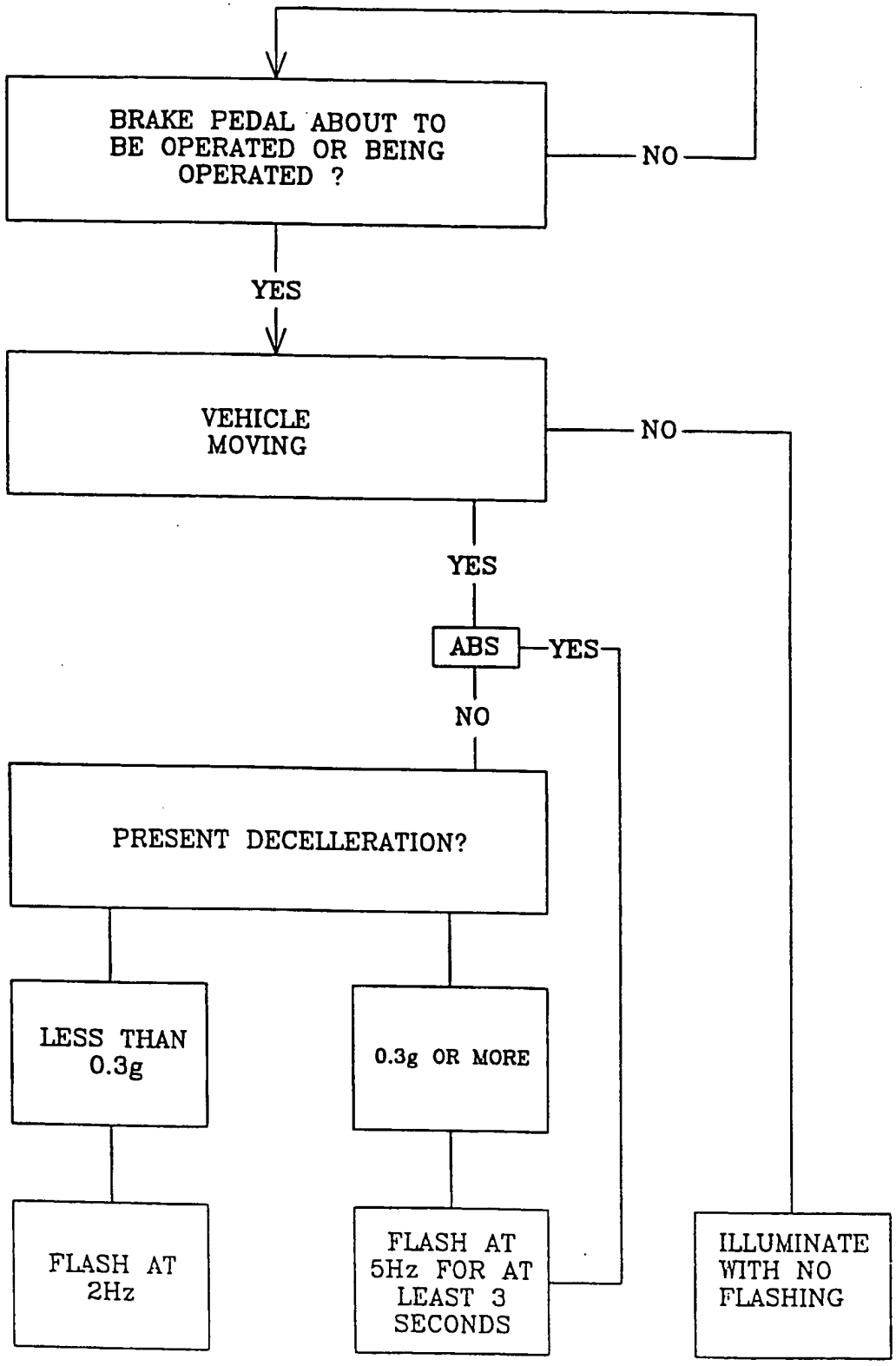

20
BRAKE PEDAL OPTICAL SENSOR
22
BRAKE PEDAL PRESSURE SENSOR
23
SPEEDOMETER
28
ABS
24
25
DECELLERATION SENSOR
26
DELAY
27
SUBTRACT
21
CONTROL
FLASHER/ TIMER
29
LED LIGHTS
30

FIG 4

FIG 5


BRAKE PEDAL ABOUT TO BE OPERATED OR BEING OPERATED ?
NO
YES
VEHICLE MOVING
NO
YES
ABS
YES
NO
PRESENT DECELLERATION?
LESS THAN 0.3g
0.3g OR MORE
FLASH AT 2Hz
FLASH AT 5Hz FOR AT LEAST 3 SECONDS
ILLUMINATE WITH NO FLASHING

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/00107

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B60Q 1/44
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B60Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 May 2001	30 -05- 2001
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/00107

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

30/04/01

International application No.
PCT/SE 01/00107

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